

Listing of Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

1. (currently amended) A method of processing a single channel audio signal to provide an audio signal having left and right channels corresponding to a virtual sound source at a given direction in space relative to a preferred position of a listener in use, the space including a forward hemisphere and a rearward hemisphere relative to said preferred position, the information in the channels including cues for perception of the direction of said single channel audio signal from said preferred position, the method including the steps of:

i) providing a two channel signal having the single channel audio signal in each of the two channels; and

ii) binaural processing the two channel signal using one of a plurality of head response transfer functions (HRTF) to provide a right signal in one channel for the right ear of a listener and a left signal in the other channel for the left ear of the listener, wherein the binaural processing of the two channel signal is augmented using high frequency (HF)-cut filtering for virtual source positions in the rearward hemisphere, the amount of the HF-cut filtering being settable according to the given direction of the virtual sound source relative to said preferred position and wherein the amount of HF cut filtering decreases as the given direction approaches the forward hemisphere ~~is substantially the same for each of the left and right channels.~~

2. (original) A method as claimed in claim 1 in which the amount of HF-cut filtering is at a maximum for virtual sound sources placed directly behind the preferred position of the listener, that is, at a direction of azimuth $\pm 180^\circ$ and elevation 0° relative to the preferred position of the listener, and the amount of HF-cut filtering progressively decreases as the forward hemisphere is approached.

3. (currently amended) A method of processing a single channel audio signal to provide an audio signal having left and right channels corresponding to a virtual sound source at a given direction in space relative to a preferred position of a listener in use, the space including a forward hemisphere and a rearward hemisphere relative to said preferred position, the information in the channels including cues for perception of the direction of said single channel audio signal from said preferred position, the method including the steps of:

i) providing a two channel signal having the single channel audio signal in each of the two channels; and

ii) binaural processing the two channel signal using one of a plurality of head response transfer functions (HRTF) to provide a right signal in one channel for the right ear of a listener and a left signal in the other channel for the left ear of the listener, wherein the binaural processing of the two channel signal is augmented using high frequency (HF)-cut filtering for virtual source positions in the rearward hemisphere, the amount of the HF-cut filtering being settable according to the given direction of the virtual sound source relative to said preferred position and wherein A method as claimed in claim 1 in which there is zero HF-cut filtering for virtual sound sources placed at directions of azimuth between 0° and ±90° relative to the preferred position of the listener.

4. (original) A method as claimed in claim 1 in which the left and right channel signals are processed by transaural crosstalk cancellation means in order to give loudspeaker compatible signals.

5. (previously presented) A method as claimed in claim 1 in which the degree of HF-cut filtering is determined by filter coefficients set according to a function of the angle of azimuth and the angle of elevation of the virtual sound source.

6. (original) A method as claimed in claim 1 in which the amount of HF-cut filtering is substantially the same for virtual sound sources placed at positions on the rear

hemisphere which are equidistant from azimuth $\pm 180^\circ$ and elevation 0° relative to the preferred position of the listener.

7. (previously presented) A method as claimed in claim 1, in which the degree of HF-cut filtering is determined by filter coefficients set via a look-up table.

8. (previously presented) A method as claimed in claim 1 in which the HF-cut filtering is performed in series with an HRTF.

9. (previously presented) A method as claimed in claim 1 in which an HRTF is convolved with an HF-cut filter to produce a modified HRTF.

10. (original) Apparatus for performing the method as claimed in claim 1, including signal processing means, HRTF filter means, HF-cut filter means, and a means for determining HF-cut filter coefficients as a function of the direction of the virtual sound source.

11 – 12. canceled.

13. (currently amended) A software product, comprising:

a computer readable medium having stored thereon a computer program for implementing a method of processing a single channel audio signal to provide an audio signal having left and right channels corresponding to a virtual sound source at a given direction in space relative to a preferred position of a listener in use, the space including a forward hemisphere and a rearward hemisphere relative to said preferred position, the information in the channels including cues for perception of the direction of said single channel audio signal from said preferred position, the method including the steps of:

i) providing a two channel signal having the single channel audio signal in each of the two channels; and

ii) binaural processing the two channel signal using one of a plurality of head response transfer functions (HRTF) to provide a right signal in one channel for the right ear of a listener and a left signal in the other channel for the left ear of the listener,

wherein the binaural processing of the two channel signal is augmented using high frequency (HF)-cut filtering for virtual source positions in the rearward hemisphere, the degree of the HF-cut filtering being settable according to the given direction of the virtual sound source relative to said preferred position and wherein the amount of HF cut filtering decreases as the given direction approaches the forward hemisphere and is substantially the same for each of the left and right channels.

14. (currently amended) An audio signal, comprising left and right channels corresponding to a virtual sound source at a given direction in space relative to a preferred position of a listener in use, the space including a forward hemisphere and a rearward hemisphere relative to said preferred position, information in the channels including cues for perception of the direction of a single channel audio signal from said preferred position, wherein said audio signal is processed from the single channel audio signal in accordance with the steps of:

i) providing a two channel signal having the single channel audio signal in each of the two channels; and

ii) binaural processing the two channel signal using one of a plurality of head response transfer functions (HRTF) to provide a right signal in one channel for the right ear of a listener and a left signal in the other channel for the left ear of the listener, wherein the binaural processing of the two channel signal is augmented using high frequency (HF)-cut filtering for virtual source positions in the rearward hemisphere, the degree of the HF-cut filtering being settable according to the given direction of the virtual sound source relative to said preferred position and wherein the amount of HF cut filtering decreases as the given direction approaches the forward hemisphere and is substantially the same for each of the left and right channels..

15. (currently amended) An apparatus for producing an audio signal, comprising:
a signal processor;

an HRTF filter;

an HF-cut filter;

an HF-cut filter coefficient determining circuit which determines the HF-cut filter coefficients as a function of a virtual sound source;

wherein the audio signal is processed from a single channel audio signal to provide the audio signal having left and right channels corresponding to the virtual sound source at a given direction in space relative to a preferred position of a listener in use, the space including a forward hemisphere and a rearward hemisphere relative to the preferred position, information in the channels including cues for perception of the direction of the single channel audio signal from the preferred position;

wherein the apparatus provides HRTF filtering to modify a two channel signal having the same single channel signal in the two channels by modifying both of the channels using one of a plurality of head response transfer functions to provide a right signal in one channel for the right ear of a listener and a left signal in the other channel for the left ear of the listener, a time delay being introduced between the channels corresponding to the inter-aural time difference for a signal coming from said given direction; and

wherein the signal in both channels is further filtered using said HF-cut filter for virtual sound source positions in the rearward hemisphere, the filter characteristics of which are settable according to the given direction of the virtual sound source and wherein the amount of HF cut filtering decreases as the given direction approaches the forward hemisphere and is substantially the same for each of the left and right channels.

16. (new) The method as recited in claim 1 wherein the amount of HF cut filtering is substantially the same for each of the left and right channels.